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Selected US specifications from IPC sub-classes H02K
H01R

(54) Electric motor having a spark-quenched commutator

(57) An electric motor commutator has a plurality of commutator segments 4 have rotor winding terminals 3 mounted on an insulating support 2 in angularly spaced relation by means of a press fit washer 5. A generally disc shaped electrically conductive ring 3 formed of an elastomeric material is fitted to the insulating support 2 and brought into intimate electrical contact with the terminals 4 by the application of heat which may be that from soldering/welding wires to the terminals. The ring serves as a spark-quenching resistor for the commutator segments. Alternatively the ring 3 may be fitted over the segments, Fig. 4.

FIG. 1

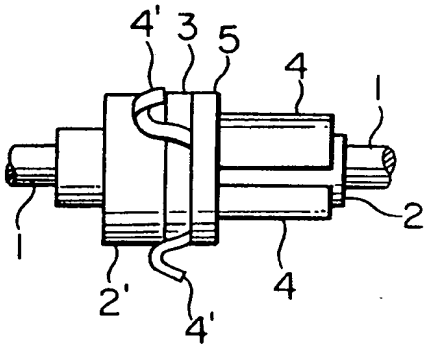

FIG. 4

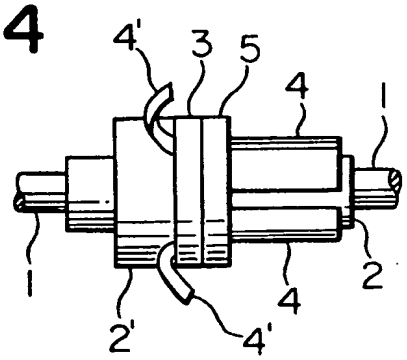

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FIG. 1

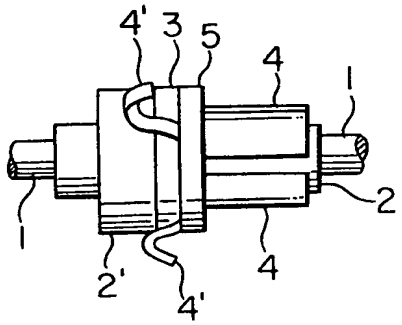


FIG. 2A

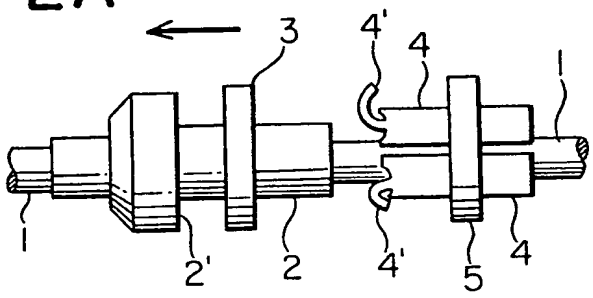


FIG. 2B

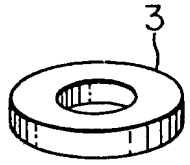


FIG. 2C

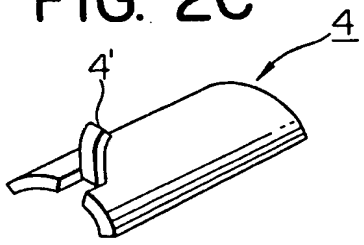
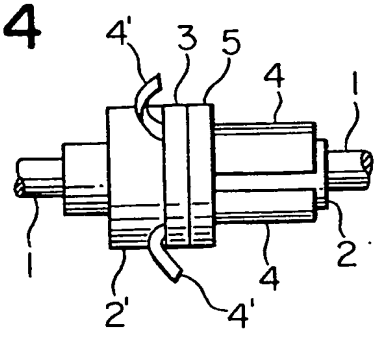


FIG. 4



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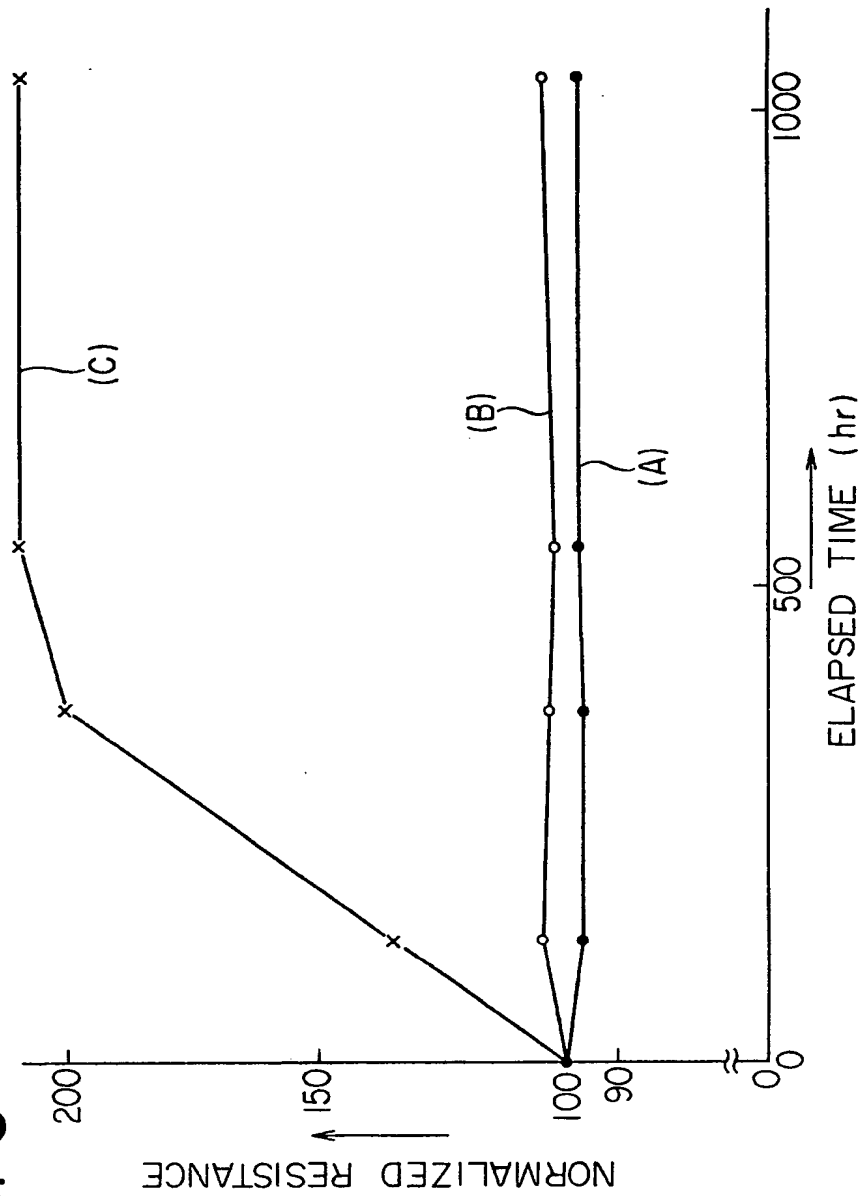

FIG. 3

SPECIFICATION

Electric motor and commutator therefor

This invention relates to electric motors and to commutators for use therein.

Rotary electric motors are commonly provided with a commutator comprising a plurality of commutator segments mounted on an insulating support in angularly spaced relation thereabout, the segments being provided with terminals adapted for connection to the rotor windings.

In such motors, and particularly in so-called "miniature electric motors", there is a tendency for sparks to be generated between the commutator segments and the brushes in operation of the motor and an evident need for a spark-quenching means to suppress generation of such sparks.

A number of previous proposals have been made for quenching sparks in such motors. One such proposal is to utilise a ring on which thick-film resistors, as many as the rotor poles, are disposed on a generally ring-shaped printed circuit board with the adjoining thick-film resistors being connected with copper foil, for example. The copper foil is soldered to the commutator segments. We have found that this is a relatively expensive arrangement to provide in miniature electric motors, where there is a very great need to keep the cost of manufacture to a minimum.

Another proposed arrangement has involved the connection of the rotor windings to commutator terminals which are integral with the respective commutator segments, and then to adhere a short cylindrical electrically conductive rubber member by means of electrically conductive adhesive so as to cover the commutator segments. This approach requires the selection and utilisation of an electrically conductive adhesive.

We have now found that it is possible to provide commutator segments and an electrically conductive elastomeric ring which are capable of being brought into intimate electrical contact simply by the application of heat to provide a satisfactory spark-quenching arrangement.

Accordingly, the invention provides in a first aspect thereof a commutator for an electric motor, comprising: a plurality of commutator segments mounted on an insulating support in angularly spaced relation thereabout, each said segment being provided with a terminal adapted for connection to the rotor windings of the motor; and a generally disc shaped electrically conductive ring formed of an elastomeric material, fitted to said insulating support and brought into intimate electrical contact with said terminals by the application of heat, said ring serving as a spark-quenching resistor for said commutator segments.

In a second and alternative aspect of this invention, we provide an electric motor of the kind having a rotor with rotor windings mounted on a rotor shaft for rotation relative to a stator, the motor having a commutator comprising a plurality of commutator segments mounted on an insulating support in angularly spaced relation thereabout, the insulating support being mounted on the rotor shaft, and each said segment being provided with a terminal, a generally disc shaped electrically conductive ring formed of an elastomeric material being fitted to said insulating support, and the rotor windings being electrically connected to the said terminals by soldering or welding under heating conditions sufficient to bring the ring into intimate electrical contact with the said terminals, the said ring serving as a spark-quenching resistor for said commutator segments.

The invention is hereinafter more particularly described by way of example only with reference to the accompanying drawings, in which:—

Figure 1 is a side elevational view of an embodiment of commutator produced in accordance with the present invention;

Figure 2A is a diagram useful for explaining a process for the assembly of the embodiment of commutator shown in Fig. 1;

Figure 2B is a perspective view of an electrically conductive elastomeric ring useful in the commutator of Fig. 1;

Figure 2C is an enlarged perspective view of an individual commutator segment;

Figure 3 is a graph illustrating changes in resistance with time with a practical embodiment of commutator constructed in accordance with the present invention, comparing the said commutator with an otherwise similar commutator utilising electrically conductive adhesive to provide electrical contact between the commutator terminals and an electrically conductive rubber ring and a further commutator otherwise similar to the second commutator but omitting the adhesive; and

Figure 4 is a view generally similar to Fig. 1 but illustrating an alternative embodiment of commutator constructed in accordance with the present invention.

Fig. 1 shows an embodiment of commutator constructed in accordance with the present invention mounted upon a rotor shaft 1. The commutator has an insulating support comprising an insulating cylinder 2 with an integral flange 2'. The electrically conductive elastomeric ring is shown at 3. A plurality of segments 4, each having a terminal 4' are mounted on the insulating

support angularly spaced thereabout. An insulating washer 5 assists in holding the commutator segments firmly on the insulating cylindrical support 2.

Referring now to Fig. 2A, the commutator may readily be assembled by first mounting the insulating support 2,2' upon the rotor shaft 1. Thereafter, the electrically conductive elastomeric ring 3, best shown in Fig. 2B, is fitted on to the insulating cylinder 2 and slid therealong in the direction of the arrow shown in Fig. 2A until it comes into contact with the flange 2'. Next, the individual commutator segments 4, best shown in Fig. 2C, are disposed about the insulating cylinder 2 with the terminals being placed in contact with the ring 3. The insulating washer 5 is then press fitted over the commutator segments 4, again being pushed in the direction of the arrow in Fig. 2A. With this arrangement, in which the commutator terminals 4 are kept pressed against the electrically conductive ring 3 by the washer 5, when the commutator is offered up to the rotor windings and these are soldered or welded to the terminals 4', the heat generated is sufficient to bring the terminals and the ring 3 into intimate electrical contact.

As will be seen from Table 1 below and Fig. 3 of the accompanying drawings, we have found that this procedure results in a commutator in which the suppression of sparks is at least as good as in a comparable commutator in which adhesive rather than heat is used to bring the ring into electrical contact with the commutator terminals.

Table 1 shows measured values for resistance which have been normalised to 100 for the starting resistance at Time Zero (the normalised values being shown in brackets). The resistance measurements were all made at an atmospheric temperature of 50°C and relative humidity of 95%. In Table 1 the values given at (A) relate to an embodiment of commutator constructed in accordance with the present invention, those shown at (B) being obtained from an otherwise similar commutator in which an electrically conductive rubber ring is placed in electrical contact with the terminals by means of an electrically conductive adhesive rather than by application of heat, and the results given at (C) relate to a commutator otherwise similar to the commutator (B) but with the electrically conductive adhesive omitted. Values were obtained at various times in hours.

Table 1

TIME	0	131	371	539	1035
(A)	385	374	375	377	379
	(100)	(97)	(97)	(98)	(98)
(B)	195	205	203	200	204
	(100)	(105)	(104)	(103)	(105)
(C)	500	675	1000	2000	5000
	(100)	(135)	(200)	(400)	(1000)

Fig. 3 plots normalised resistance in Table 1 as ordinate against elapsed time in hours as abscissa.

The technical and commercial advantage of the commutator constructed in accordance with the present invention (A), avoiding as it does the need for application of electrically conductive adhesive will be immediately apparent from Fig. 3.

Fig. 4 illustrates an alternative embodiment, like reference numerals being employed to those shown in Fig. 1.

As will be seen, in this arrangement, terminals 4' are trapped between the flange 2' and the electrically conductive ring 3, the constructive otherwise being the same. The order of assembly will need to be appropriately modified in order to achieve this configuration of assembly. We have found that the results obtained are comparable with those for the Fig. 1 embodiment.

The elastomeric material of the ring 3 is suitably a natural or artificial rubber which has been deliberately made electrically conductive.

CLAIMS

1. A commutator for an electric motor, comprising: a plurality of commutator segments

mounted on an insulating support in angularly spaced relation thereabout, each said segment being provided with a terminal adapted for connection to the rotor windings of the motor; and a generally disc shaped electrically conductive ring formed of an elastomeric material, fitted to said insulating support and brought into intimate electrical contact with said terminals by the application of heat, said ring serving as a spark-quenching resistor for said commutator segments.

2. A rotary electric motor in which a commutator according to Claim 1 is mounted on the rotor shaft with the said terminals coupled to the rotor windings.

3. An electric motor of the kind having a rotor with rotor windings mounted on a rotor shaft for rotation relative to a stator, the motor having a commutator comprising a plurality of commutator segments mounted on an insulating support in angularly spaced relation thereabout, the insulating support being mounted on the rotor shaft, and each said segment being provided with a terminal, a generally disc shaped electrically conductive ring formed of an elastomeric material being fitted to said insulating support, and the rotor windings being electrically connected to said terminals by soldering or welding under heating conditions sufficient to bring the ring into intimate electrical contact with the said terminals, the said ring serving as a spark-quenching resistor for said commutator segments.

4. An electric motor substantially as hereinbefore described with reference to the accompanying drawings.

5. A commutator for an electric motor, the commutator being substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

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